

Electrostatic Sample Levitator
for Containerless Materials Processing

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ABSTRACT

There are wide variety of metastable states, ranging from metastable crystalline phases (supersaturated and grain-refined alloys) to amorphous metals. Detailed knowledge on thermodynamics and thermophysical properties of these materials will lead to comprehensive understanding of nucleation and solidification processes to form these materials. In the high temperature materials processing, for reasons of maintaining purity of sample materials and attaining deeply undercooled states of melts, samples have to be isolated from container walls using some kind of levitation methods.

In this presentation a new levitator that was developed for the containerless materials processing will be presented. The system is operated in high vacuum and can heat a sample higher than 2000 K. Advantages of the electrostatic levitation technique over the other levitation techniques, especially the electromagnetic levitation, is in the decoupling of the levitation and the heating elements, thus allowing accurate calorimetry at any temperature between the room and the maximum allowable temperatures. The electrostatic levitator can handle both conductive and non-conductive materials. To measure thermophysical properties, various non-invasive diagnostic techniques are used. Properties that can be measured include the true temperature, the spectral emissivity, the density (specific volume), the hemispherical total emissivity, the specific heat, the surface tension, the viscosity, and the electrical conductivity.